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**JUN 08 2015**

U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555-0001

10 CFR 50.73

**SUSQUEHANNA STEAM ELECTRIC STATION  
LICENSEE EVENT REPORT 50-388/2015-003-00  
UNIT 2 LICENSE NO. NPF-22  
PLA-7344**

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**Docket No. 50-388**

Attached is Licensee Event Report (LER) 50-388/2015-003-00. On April 10, 2015, at 2346 hours, the Susquehanna Steam Electric Station (SSES) reactor automatically scrammed due to a main turbine trip caused by a loss of turbine steam seals and degraded main condenser vacuum.

In accordance with 10 CFR 50.73(a)(2)(iv)(A), this LER is being submitted for any event or condition that resulted in an automatic actuation of the Reactor Protection System (RPS) when the reactor is critical, and for any event or condition that resulted in automatic actuation of the RPS including a reactor scram.

There were no actual consequences to the health and safety of the public as a result of this event.

This letter contains no new regulatory commitments.


A handwritten signature in cursive script, appearing to read "J. A. Franke".

J. A. Franke

Attachment: LER 50-388/2015-003-00

Copy: NRC Region I  
Mr. B. Fuller, PA DEP/BRP  
Mr. J. E. Greives, NRC Sr. Resident Inspector  
Mr. J. A. Whited, NRC Project Manager



<b>NRC FORM 366</b> (02-2014)		<b>U.S. NUCLEAR REGULATORY COMMISSION</b>			<b>APPROVED BY OMB: NO. 3150-0104</b>		<b>EXPIRES: 01/31/2017</b>			
		<b>LICENSEE EVENT REPORT (LER)</b> (See Page 2 for required number of digits/characters for each block)			Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to <a href="mailto:Infocollections.Resource@nrc.gov">Infocollections.Resource@nrc.gov</a> , and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.					
<b>1. FACILITY NAME</b> Susquehanna Steam Electric Station Unit 2					<b>2. DOCKET NUMBER</b> 05000388		<b>3. PAGE</b> 1 of 5			
<b>4. TITLE</b> Unit 2 Automatic Reactor Scram Caused by Main Turbine Trip Due to Loss of Main Condenser Vacuum										
<b>5. EVENT DATE</b>			<b>6. LER NUMBER</b>			<b>7. REPORT DATE</b>			<b>8. OTHER FACILITIES INVOLVED</b>	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
04	10	2015	2015	- 003	00	06	08	2015	FACILITY NAME	DOCKET NUMBER
<b>9. OPERATING MODE</b>		<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)</b>								
<b>10. POWER LEVEL</b>  37%		<input type="checkbox"/> 20.2201(b)		<input type="checkbox"/> 20.2203(a)(3)(i)		<input type="checkbox"/> 50.73(a)(2)(i)(C)		<input type="checkbox"/> 50.73(a)(2)(vii)		
		<input type="checkbox"/> 20.2201(d)		<input type="checkbox"/> 20.2203(a)(3)(ii)		<input type="checkbox"/> 50.73(a)(2)(ii)(A)		<input type="checkbox"/> 50.73(a)(2)(viii)(A)		
		<input type="checkbox"/> 20.2203(a)(1)		<input type="checkbox"/> 20.2203(a)(4)		<input type="checkbox"/> 50.73(a)(2)(ii)(B)		<input type="checkbox"/> 50.73(a)(2)(viii)(B)		
		<input type="checkbox"/> 20.2203(a)(2)(i)		<input type="checkbox"/> 50.36(c)(1)(i)(A)		<input type="checkbox"/> 50.73(a)(2)(iii)		<input type="checkbox"/> 50.73(a)(2)(ix)(A)		
		<input type="checkbox"/> 20.2203(a)(2)(ii)		<input type="checkbox"/> 50.36(c)(1)(ii)(A)		<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)		<input type="checkbox"/> 50.73(a)(2)(x)		
		<input type="checkbox"/> 20.2203(a)(2)(iii)		<input type="checkbox"/> 50.36(c)(2)		<input type="checkbox"/> 50.73(a)(2)(v)(A)		<input type="checkbox"/> 73.71(a)(4)		
		<input type="checkbox"/> 20.2203(a)(2)(iv)		<input type="checkbox"/> 50.46(a)(3)(ii)		<input type="checkbox"/> 50.73(a)(2)(v)(B)		<input type="checkbox"/> 73.71(a)(5)		
		<input type="checkbox"/> 20.2203(a)(2)(v)		<input type="checkbox"/> 50.73(a)(2)(i)(A)		<input type="checkbox"/> 50.73(a)(2)(v)(C)		<input type="checkbox"/> OTHER		
<input type="checkbox"/> 20.2203(a)(2)(vi)		<input type="checkbox"/> 50.73(a)(2)(i)(B)		<input type="checkbox"/> 50.73(a)(2)(v)(D)		Specify in Abstract below or in NRC Form 366A				
<b>12. LICENSEE CONTACT FOR THIS LER</b>										
<b>LICENSEE CONTACT</b> Brenda W. O'Rourke, Senior Engineer – Nuclear Regulatory Affairs								<b>TELEPHONE NUMBER (Include Area Code)</b> (570) 542-1791		
<b>13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT</b>										
CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	
<b>14. SUPPLEMENTAL REPORT EXPECTED</b>						<b>15. EXPECTED SUBMISSION DATE</b>				
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE)						<input checked="" type="checkbox"/> NO				
<b>ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)</b> On April 10, 2015, at 2100 hours, a planned shutdown for the Susquehanna Unit 2 refueling outage commenced. With shutdown in progress and at approximately 37% power for balance of plant operations, a pre-job brief was conducted in preparation for placing an Auxiliary Boiler in service and placing the Main Turbine Steam Seals on Auxiliary Steam. At 2129 hours, the 'A' Auxiliary Boiler was placed in service per procedure OP-027-001, "Aux Boiler System," and the Main Turbine Steam Seals were placed on auxiliary steam via valve 221008, "SJAЕ and Steam Seal Aux Supply Iso Vlv." At approximately 2330 hours, the procedure was resumed which directed closure of valve 221008 when Auxiliary Boiler temporary load is no longer needed. At this point, temporary load was no longer needed but auxiliary steam was still flowing through valve 221008, supplying steam to the Unit 2 Main Turbine Steam Seals. The valve was subsequently closed, which isolated steam to the U2 Main Turbine Steam Seals, allowing air in-leakage into the Main Condenser, causing condenser vacuum to degrade. At 2346 hours, Unit 2 automatically scrambled from approximately 37 percent power due to a the Main Turbine trip on loss of condenser vacuum.  <u>Root Cause:</u> Personnel involved with auxiliary boiler startup did not adhere to Operator Fundamentals and effectively apply appropriate Human Performance error-reduction tools specific to understanding and anticipating the impact of component operation prior to its operation. <u>Completed Action:</u> Procedure OP-027-001, "Auxiliary Boiler System," was revised to caution operators of the potential for isolating auxiliary steam to the Main steam seals and/or Steam Jet Air Ejectors when securing temporary loading of the auxiliary boilers. <u>Key Planned Action:</u> Provide initial licensed and non-licensed operator classroom and job performance measure or dynamic learning activity training with focus on: STAR, Questioning Attitude, Pre-job Brief, and understand and anticipate the impact of component operation prior to its operation. <u>Safety Significance:</u> There were no actual consequences to the health and safety of the public as a result of this event.						MONTH	DAY	YEAR		



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to [Infocollections.Resource@nrc.gov](mailto:Infocollections.Resource@nrc.gov), and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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**NARRATIVE****CONDITIONS PRIOR TO THE EVENT**

Unit 1 – Mode 1, 100 percent Rated Thermal Power

Unit 2 – Mode 1, 37 percent Rated Thermal Power

There were no systems, structures, or components that were inoperable at the start of the event and contributed to the event.

**EVENT DESCRIPTION**

On April 10, 2015, at 2100 hours, a planned shutdown for the 17<sup>th</sup> Refueling and Inspection Outage (U2-17RIO) for Susquehanna Unit 2 commenced. During the down power, the “C” Reactor Feed Pump (RFP) and “C” Condensate Pump were removed from service per plant procedures. With the Unit 2 shutdown in progress and at approximately 37% power for balance of plant operations, a pre-job brief was conducted by nuclear plant operators (NPOs) and plant control operators (PCOs) in preparation for placing an Auxiliary Boiler in service and placing the Main Turbine Steam Seals on Auxiliary Steam.

In accordance with procedure OP-027-001, Aux Boiler System,” Step 5.5.1.f requires a “Critical” brief be conducted when placing the Auxiliary Boiler in service. Because a specific pre-job brief for placing the Main Turbine Steam Seals on Auxiliary Steam did not exist, a pre-job brief checklist template was used concurrently with procedure OP-292-001 “Seal Steam System” during the brief. Procedure OP-027-001 states that extended periods of Auxiliary Boiler operation with no load will cause excessive cycling of the Auxiliary Boiler feed pump OP126A. If there is an anticipated delay (in loading the Auxiliary Boiler) of greater than 30 minutes, and the Auxiliary Boiler is to remain in service, OP-027-001 Step 5.5.4 directs placing a temporary steam load on the Auxiliary Boiler. This is accomplished by opening valve 221008 “SJAE and Steam Seal Aux Supply Iso Vlv”, and then opening a downstream drain valve to the Main Condenser.

At 2129 hours, the “A” Auxiliary Boiler was subsequently placed in service (as directed by procedure OP-027-001) by the NPOs. The Auxiliary Boiler was then aligned to the Unit 2 Temporary Loading by directing the nuclear plant operator to open valve 221008, and then contact the control room to open HV-20765 “Sealing Steam Aux Steam Supply Drain Vlv”. With Auxiliary Steam now available to the Unit 2 Main Turbine Steam Seals through valve 221008, the U2 Steam Seals were placed on Auxiliary Steam per procedure OP-292-001 (procedure Step 2.3.3 requires that valve 221008 remain open as long as Auxiliary Steam is supplying steam to the Main Turbine Steam Seals).

At approximately 2330 hours, the NPOs resumed procedure OP-027-001 at Step 5.5.4.c, which directs closure of valve 221008 “SJAE and Steam Seal Aux Supply Iso Vlv” when Auxiliary Boiler temporary load is no longer needed. Although temporary load was no longer needed at this point; auxiliary steam was still flowing through valve 221008 “SJAE and Steam Seal Aux Supply Iso Vlv”, supplying steam to the Unit 2 Main Turbine Steam Seals.

The NPO contacted the PCO in the control room to communicate that valve 221008 was being closed (but did not communicate the valve’s noun name). The PCO confirmed the step in procedure OP-027-001 using the valve number only, and concurred with the valve manipulation. The NPO then closed valve 221008, which

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**NARRATIVE****EVENT DESCRIPTION (Cont.)**

isolated steam to the U2 Main Turbine Steam Seals. By closing this valve, the steam supply to the Main Turbine Steam Seals was removed, allowing air in-leakage into the Main Condenser, causing condenser vacuum to degrade.

At approximately 2342 hours, the Steam Jet Air Ejector (SJAE) and Steam Seal Aux Steam Supply Isolation Valve 221008 was closed. This caused a loss of steam to the Main Turbine steam seals, resulting in a rapid loss of vacuum to the Main Turbine and subsequent rise in Main Condenser back pressure.

At 2346 hours, Unit 2 automatically scrammed from approximately 37 percent power due to a the Main Turbine trip on loss of condenser vacuum, resulting in a reactor scram on Turbine Control Valve Fast Closure. The mode switch was subsequently placed in Shutdown. Emergency procedures were entered due to Reactor Water level less than +13 inches, reactor scram and loss of condenser vacuum.

All control rods fully inserted. The Reactor Protection System (RPS) responded as expected. Reactor water level lowered to +2.56 inches following the scram. There were no automatic Emergency Core Cooling System (ECCS) or Reactor Core Isolation Cooling (RCIC) initiations. No safety relief valves opened during the event. The "A" RFP was tripped due to vacuum concerns and RCIC was manually initiated for Reactor Pressure Vessel (RPV) level control until Main Condenser vacuum was recovered.

The Reactor Recirculation Pumps (RRP) tripped due to End-of-Cycle/Recirculation Pump Trip (EOC/RPT) during the event and the Main Steam Isolation Valves (MSIVs) remained opened as expected. RPV pressure was controlled via bypass valves and a cooldown was initiated.

**REPORTABILITY**

On April 11, 2015, at 0152 hours, this condition was determined to be reportable as a 4 hour ENS (#50973) in accordance with 10 CFR 50.72(b)(2)(iv)(B) for any event or condition that results in actuation of the reactor protection system (RPS) when the reactor is critical, and as an 8 hour notification in accordance with 10 CFR 50.72(b)(3)(iv)(A) for any event or condition that resulted in the valid actuation of RPS including a reactor scram.

In accordance with 10 CFR 50.73(a)(2)(iv)(A), this Licensee Event Report is being submitted for any event or condition that resulted in an automatic actuation of RPS when the reactor is critical, and for any event or condition that resulted in automatic actuation of the RPS including a reactor scram.

**CAUSE OF THE EVENT**

The root cause of the event was personnel involved with auxiliary boiler startup did not adhere to Operator Fundamentals and effectively apply appropriate Human Performance error-reduction tools, specific to understanding and anticipating the impact of component operation prior to its operation. The Nuclear Plant Operators (NPO) and Plant Control Operators (PCO) who briefed and performed the auxiliary boiler startup and temporary loading did not adhere to the following Operator Fundamentals:



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**NARRATIVE**

## **CAUSE OF THE EVENT (Cont.)**

- Prepare for operational evolutions to ensure that the effects of actions are understood
- Anticipate the impact of component operation prior to its operation
- Understand the how and why of your actions prior to proceeding
- Before operating a component, confirm an understanding of its function and interactions with other components
- Coordinate field and control room activities to achieve intended results

In addition, these NPOs and PCOs did not effectively apply the following Human Performance error reduction tools: Pre-job Brief, Questioning Attitude, and Stop, Think, Act, Review (STAR).

The auxiliary boiler procedure OP-027-001, when used concurrently with Seal Steam System procedure OP-292-001, contained a decision step that isolated steam to turbine seals. As a result, when following the procedures as-written, a turbine trip can occur. When temporary loading of the auxiliary boilers is secured after steam seals have already been transferred to auxiliary steam, the steam supply to the steam seals is also secured. The procedure did not alert users to this situation, but instead relied on operator understanding and anticipation.

## **ANALYSIS/SAFETY SIGNIFICANCE**

### **Potential Consequences**

A risk significance determination assessment was performed for the April 10, 2015 Unit 2 scram event. The risk assessment concluded:

The Unit 2 risk significance and potential consequences for the initiating event experienced on April 10, 2015 due to a Turbine Trip with Bypass Available event was less than 1E-06 for CDP [Core Damage Probability] and 1E-07 for LERP [Large Early Release Probability] significance thresholds as outlined in [NRC Inspection Manual] IMC609. These thresholds represent a GREEN significance level and are of "Very Low Safety Significance. This determination is based on the PRA JUL12R1 online risk model of record.

### **Actual Consequences**

The actual consequence of this event was a U2 reactor scram from approximately 37% reactor power during a planned plant shutdown. There was no nuclear safety, radiological safety, environmental safety, or industrial safety consequences.

As such, there were no actual consequences to the health and safety of the public as a result of this event.

## **CORRECTIVE ACTIONS**

### **Key Completed Action –**

- Revised procedure OP-027-001, "Auxiliary Boiler System," to caution operators of the potential for isolating auxiliary steam to the steam seals and/or Steam Jet Air Ejectors when securing temporary loading of the auxiliary boilers.

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**NARRATIVE**

**CORRECTIVE ACTIONS (Cont.)**

Key Planned Action –

- Provide initial licensed and non-licensed operator classroom and job performance measure (JPM) or dynamic learning activity (DLA) training with focus on: Stop, Think, Act, Review (STAR), Questioning Attitude, Pre-job Brief (print reading), and understand and anticipate the impact of component operation prior to its operation.
- Develop a training effectiveness evaluation worksheet and provide licensed and non-licensed operator requalification classroom and JPM or DLA training with focus on: STAR, Questioning Attitude, Pre-job Brief (print reading), and understand and anticipate the impact of component operation prior to its operation.

**PREVIOUS SIMILAR EVENTS**

None